OFR-75-507

Introduction

Petroleum lease sales of the outer continental shelf (OCS) in the northern Gulf of Alaska appear imminent (Dec. 1975). Because of the impending offshore exploration and sub-sea construction activities which will follow the sale, information is needed about the shelf sediments. Knowledge of thickness of Holocene sediments facilitates evaluation of environmental problems involving instability of the seafloor and areas of excessive erosion and deposition.

The data used in the construction of this isopach map of the northern Gulf of Alaska OCS area are high resolution seismic profiles collected on the cruise of the R/V THOMAS G. THOMPSON, September-October, 1974 (Inset A). These records are available in open-file (von Huene and others, 1975). Navigation instrumentation used to locate the seismic lines shown on inset A include Decca HiFix, Satellite, Loran A, and Radar. To aid in the interpretation of the seismic data, supplemental information was gleaned from shipboard sediment descriptions recorded on the cruise of the F.R.S. CROMWELL, May-June, 1975.

The four different sedimentary units in the OCS area (Molnia and Carlson, 1975a) have characteristic seismic signatures. The two youngest sedimentary units, both of which are Holocene, mantle much of the OCS region. One consists largely of clayey silt and is characterized on seismic profiles by relatively horizontal and parallel reflectors. Exceptions are in areas where slides or slumps have developed and the resulting reflectors are very disrupted (Carlson, Bruns, and Molnia, 1975) and seaward of the barrier islands of the Copper River where the principal sediment is fine sand and the reflectors are highly irregular. The second Holocene unit is present off the Bering and Malaspina Glaciers where the most recent end moraines show a jumbled mass of irregular reflectors. The Holocene unit is underlain in some parts of the OCS by a glacial marine unit of pebbly mud which is characterized on the profiles by very irregular, confused, distorted reflectors. Because of its stratigraphic position between Holocene and older rocks which range from Tertiary to Pleistocene in age, we assign a Quaternary age to this unit. Its unique seismic signature separates it from the overlying Holocene sediments and therefore it is not included within the isopached unit. In other areas of the OCS, the glacial marine unit is absent and the Holocene unit is underlain directly by folded, faulted and in many places truncated, stratified sedimentary rocks which are probably Tertiary or Pleistocene in age.

Distribution of Holocene Sediments

Holocene sediment is present throughout much of the OCS area in thicknesses varying from less than 5 metres to greater than 300 metres. The wedge of Holocene fine sand to clayey silt which makes up the Copper River prodelta is the thickest of all the modern sediments measured, reaching a thickness of about 350 metres just southeast of the main channel of the Copper River.

Other thick sequences of sediment are: (1) seaward of Icy Bay near Malaspina Glacier (260 m), (2) south of the Bering Glacier (200 m), (3) between Hinchinbrook and Montague Island (250 m), and (4) at the southwest end of Kayak Trough (155 m).

Areas Devoid of Holocene Sediment

The largest area free of Holocene sediment in the western half of the map is an irregularly shaped topographic high that includes Tarr Bank and the Middleton Island platform. Truncated, folded, and faulted sedimentary strata of probable Tertiary age appear to crop out at the seafloor on these bank areas and they are flanked by a thin band of Quaternary glacial marine pebbly mud along the west and north sides (Molnia and Carlson, 1975b). Within this area of Tertiary outcrop are small depressions filled with Holocene silty clay from two to 20 metres in thickness. Our sediment sampling suggests that much of Tarr Bank (and similar areas of the OCS tentatively identified as devoid of Holocene sediment) could be covered by a thin veneer (<2 m) of Holocene mud. This Holocene cover is not detectable on the seismic profiles because of the thinness of the sediment (<2m), which is less than the resolution of the seismic systems, and/or because of the transparent nature of the sediment.

Smaller areas in the western one-half of the map that are devoid of Holocene sediment, and apparently consists of Tertiary bedrock at the surface, are present east of Montague Island and southwest of Hinchinbrook Island. One of these areas, Seal Rocks, a small group of islands 5 km southwest of Hinchinbrook Island, is composed of well-indurated flysch-like sandstone and argillite that is identical to the Orca Formation found on both Montague and Hinchinbrook Islands (Winkler, 1973). Wessels Reef, an intertidal shoal on Tarr Bank about 15 km northeast of Middleton Island, exposes friable sandstone and granule conglomerate that is similar lithologically to rocks of the Katalla Formation on Kayak Island (Plafker, 1974; Winkler, oral commun., 1975).

The largest area devoid of Holocene sediments in the eastern one-half of the map extends along the continental slope from south of Kayak Island to the easternmost seismic profile line off the Malaspina Glacier. Much of this slope area consists of glacial marine pebbly mud. In addition, four areas of older folded and faulted sedimentary rocks crop out along the outer shelf and upper slope (Molnia and Carlson, 1975b). In a few places along the slope, some thin patches of Holocene sediment (2-20 m thick) cover the older materials. Three other areas on the shelf where older folded and faulted sedimentary rocks crop out at the seafloor are the Kayak Island platform and two structural highs near Cape Yakataga.

Sources of Sediment

The two main sources of Holocene sediment in this OCS region are the Copper River, which, according to Reimnitz (1966), annually supplies 107×10^6 metric tons of detritus, and the two large piedmont glaciers (Bering and Malaspina). The sediment being supplied from the two glaciers is at present primarily suspended matter, the plumes of which easily can be detected more than 30 km from shore on satellite imagery of the region (Reimnitz and Carlson, 1974). A secondary but significant source of fine sediment is wind which in the fall of the year often blows down the Copper River gorge with sufficient force to carry dark clouds of silt many kilometres into the northern Gulf of Alaska (Molnia and Carlson, 1975a).

The sediment, whether supplied by river, glacial runoff, or wind, is subject to the rigors of the nearshore currents which, with the exception of local eddies, move in a counter clockwise direction similar to the offshore Alaska Current (Reimnitz and Carlson, 1974). This counterclockwise movement transports the suspended sediment in a westerly direction. Much of the Copper River sediment is being carried into Prince William Sound through channels north and south of Hinchinbrook Island. Sediments which are part of the Bering Glacier runoff plume are carried around Kayak Island. Complex gyres of turbid water have been seen on both sides of Kayak Island on satellite imagery (Reimnitz and Carlson, 1974). It is likely that some of the suspended sediment settles out over Kayak trough. However, the high resolution seismic profiles indicate that very little of the suspended matter from either the Copper River or from sources east of Kayak Island accumulates on Tarr Bank or the Middleton Island platform. This lack of sediment on these topographic highs may perhaps be due to the scouring action of the frequent storm waves that are particularly large and forceful during the winter season of intense low pressure activity in the Gulf of Alaska.

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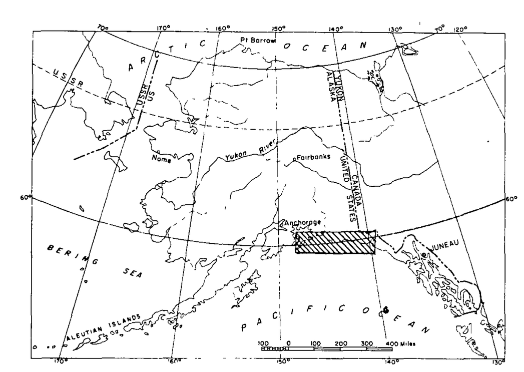
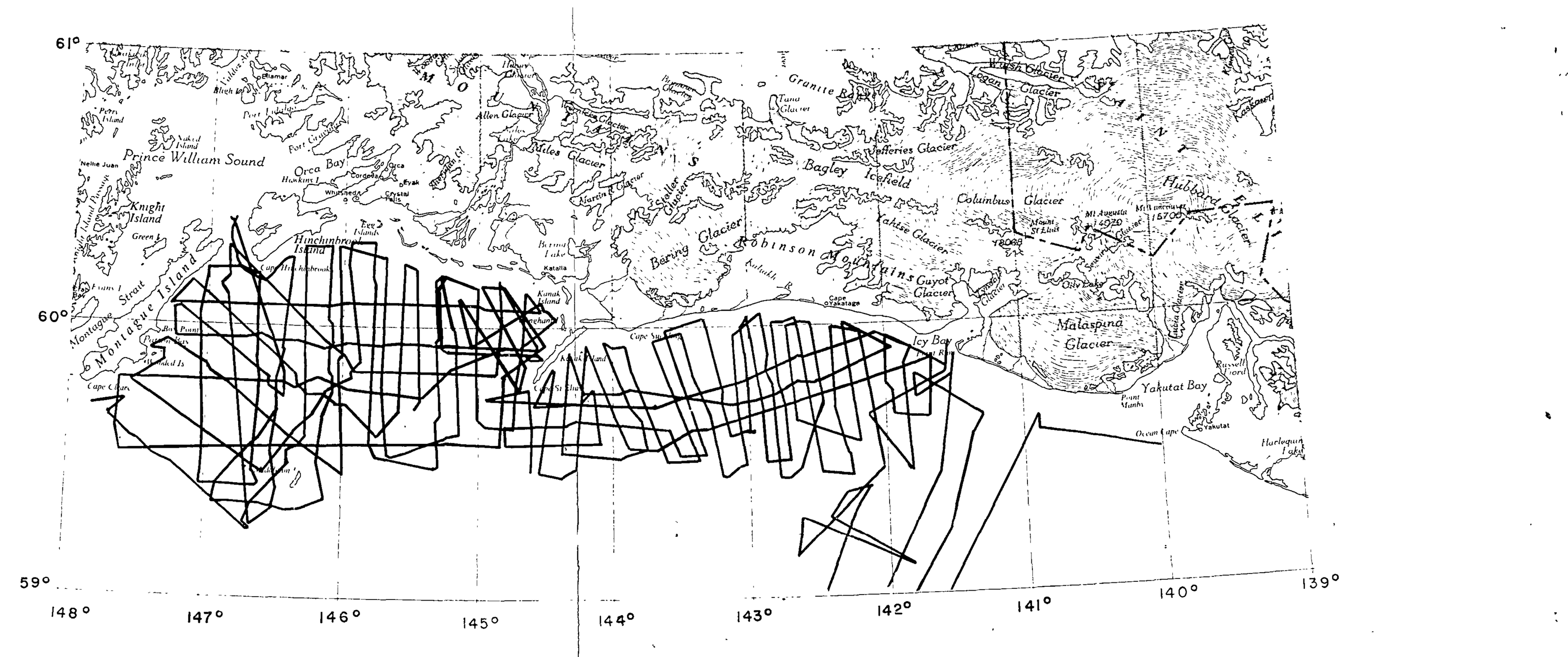
EXPLANATION

- DEVOID OF HOLOCENE SEDIMENTS
- —?—?— BOUNDARY UNCERTAIN, LIMIT OF SEISMIC PROFILES
- —25— THICKNESS CONTOURS, 25 METRE INTERVAL
- —·—·— 200 METRE ISOBATH
- TICKS SHOW DIRECTION TOWARD THICKER SEDIMENT



Index showing location of map area.



A. Map of seismic reflection lines.

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey standards and nomenclature.

PRELIMINARY ISOPACH MAP OF HOLOCENE SEDIMENTS, NORTHERN GULF OF ALASKA

By

Paul R. Carlson and Bruce F. Molnia

1975

U.S. GEOLOGICAL SURVEY
OPEN FILE MAP 75-507